Environment Perspectives of Deep Sea Mining Activities Fiji December 2013

Mineral Policy Institute

The Mineral Policy Institute [MPI] is an international civil society organisation, operating from Australia we focus on assisting communities affected by specific mining projects and on achieving mining industry reform through improvements to policy, law and practice.

MPI's role is ...... "to increase the equitable distribution of the benefits while decreasing the social injustices and environmental impacts of the mining/energy industries".

DSM Environmental Concerns: a Collaboration Opportunity for the Pacific Region - A Civil Society Perspective

- outcome is open (not pre-determined)
- access to independent information
- capacity

Drivers and restricting forces of deep sea mining

	Global	Industry	Pacific Island countries
Primary drivers	Global economic growth: supply and demand, population and consumption, increased industrialization and urbanization	Innovative, frontier field in an industry used to high-risk investment	Alternate development option: alleviate poverty, meet rising aspirations, lack of comparative advantage in other areas
	State actors: securing access to essential resources, capable of vertical integration of resource extraction and processing with product manufacture	Increasing difficulty and complexity of terrestrial mining: increasing costs, decreasing grade, slowing discovery, environmental issues, social and cultural issues	Marine minerals are a new natural resource capable of commercial exploitation in a region with few economic industries/choices
Secondary drivers	Growing societal aspirations for environmental and social sustainability	Technological improvements and scalable applicability	National independence and autonomy
	New uses/markets, the green economy		
Restricting forces	Price volatility	Availability of finance, financial uncertainty	Increasing community concerns about governance of, impact and returns from extractive industries
	Concerns over threats to marine environment, lack of marine science to inform conservation planning	Regulatory uncertainty in EEZ and the Area Significant obligations to share knowledge proceeds	Lack of governance, capacity, and regulation

TABLE 3. Our 2010 Compiled Cu Resource Data, 2010 Production, Cumulative Country Production (1800–2010), and Ratio of Resources/2010 Production

Country	Our compilation (2010)					Cumulative production	Resources/ 2010 production/
	Mt ore	% Cu	Mt Cu	No. of projects	2010 (kt Cu)	(Mt Cu)	(years)
Chile	122,767.9	0.54	658.20	51	5,418.9	126.8	121.5
USA	49,427.5	0.34	170.11	56	1,110	108.9	153.3
Peru	35,088.1	0.48	168.20	52	1,247.2	25.1	134.9
Australia	20,292.4	0.63	126.89	149	849	22.2	149.5
China					~1,195	18.4	67.3
Russia	5,516.5	1.07	59.17	14	703	47.1	84.2
Mexico	17,369.4	0.33	56.71	30	270.1	13.7	210.0
Canada	17,660.7	0.31	54.12	95	498.4	40.9	108.6
DRC	2,288.9	2.34	53.64	21	~380	20.8	141.2
Mongolia	6,265.0	0.80	50.09	2	126.1	3.62	397.2
Indonesia	7,367.9	0.67	49.61	5	872.3	16	56.9
Zambia	4,524.3	1.03	46.74	19	690	35.3	67.7
Kazakhstan	6,682.0	0.47	31.22	7	380	7.05	82.2
Poland	1,539.0	2.00	30.77	4	425.4	15.6	72.3
Argentina	7,817.6	0.37	28.76	9	140.3	2.33	205.0
Papua New Guinea	5,611.9	0.48	26.83	14	159.8	7.08	167.9

Mudd et al 2013 *A Detailed Assessment of Global Cu Resource Trends and Endowments* Economic Geology v. 108 pp 1163-1183

Table 4 Selected REE deposits classified by deposit type and with associated mineral resources and REO grades*

Project	Deposit type	Mt ore	ppm as oxide (X_2O_3)															%LREE	%HREE	Mt REO	Other metals
			La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y				
Mt Weld CLD, Australia	CAR	14·9	23 233	46 262	5020	17 639	2374	516	1060	68	243	29	58	10	29		739	9·61	0·12	1·45	
Mt Weld Duncan, Australia	CAR	9·0	12 029	19 047	2297	8653	1369	372	963	126	614	92	198	19	87	10	2501	4·47	0·36	0·44	
Olympic Dam, Australia	IOCG	9940																~0·4	~0·03	~43	Cu–U–Au–Ag
Asharam (Eldor), Canada	CAR	422·7	3609	6731	724	2575	329	77	181	18	72	10	21	2	13	2	13	1·42	0·02	6·08	
Charley Creek, Australia	ALU	805·3																0·02	0·01	0·24	
Nolan's Bore, Australia	CAR	47·3	4900	12 500	1500	5300	600	100	300	20	80	10	20	30	20	3		2·52	0·05	1·22	U–P
Norra Kärr, Sweden	ALK	58·1																0·59	0·34	Th–U	
Toongi-Dubbo, Australia	ALK	73·2															1400	0·75	0·55	Zr–Nb–Hf–Ta–U	
Bayan Obo, China	CAR	1460																~3·8	56·9		
Kvanefjeld, Greenland	ALK	619															900	~1·06	6·55	U–Zn	
Strange Lake, Canada	ALK & PEG	492·5	1200	2700	300	1100	200		200	50	320	70	220	30	220	32	2200	0·56	0·31	4·41	Th–U–Zr–Nb
Buckton, Canada	SLE	496·7	47	82	11	39	8	2	6	1	6	1	4	1	4	1	39	0·02	0·01	0·12	Th–U–Zn–Cu–Co–V–Ni–Mo–Sc–Li
Eco-Ridge MCB, Canada	PLA	37·4	368	698	70	225	39	2	26	4	17	3	7	1	6	1	7	0·14	<0·01	0·08	U–Sc
Eco-Ridge HWZ, Canada	PLA	49·2	197	371	37	119	20	1	12	2	7	1	3		2		5	0·08	<0·01	0·04	U–Sc
St Honore-Niobec, Canada	CAR	1058																1·73	18·35		
Round Top, USA	G&R	1033·8	24	95	12	34	12	0	12	4	36	9	37	8	64	10	280	0·019	0·045	0·66	
Mountain Pass, USA	CAR	16·7																7·98	1·33		
Bokan-Dotson, USA	G&R	6·7	550	1650	210	800	210	20	220	40	240	50	130	20	100	10	1,550	0·37	0·21	0·04	Th–U–Zr–Nb
Araxá, Brazil	CAR	28·3	11 801	20 780	1909	5826	627	141	288	30	121	17	33	2	17	0	474	4·14	0·07	1·19	Nb–P–Al–Fe
Songwe Hill, Malawi	CAR	56·5	2864	5193	556	1908	279	73	174	21	101	17	39	5	28	4	474	1·10	0·07	0·66	Th–U

*CAR – carbonatite; ALK – alkaline complex; PEG – pegmatites; SLE – shale; ALU/PLA – alluvial or placers and modified placers; G&R – granites and rhyolites.
MCB is main conglomerate bed. HWZ is hangingwall zone.

Weng et al. 2013 *Assessing rare earth element mineral deposit types and links to environmental impacts*. Applied Earth Science (Trans. Inst. Min. Metall. B)

The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (‘the JORC Code’) is a professional code of practice that sets minimum standards for Public Reporting of minerals Exploration Results, Mineral Resources and Ore Reserves. **The JORC Code provides a mandatory system for the classification of minerals Exploration Results, Mineral Resources and Ore Reserves** according to the levels of confidence in geological knowledge and technical and economic considerations in Public Reports. **Public Reports prepared in accordance with the JORC Code are reports prepared for the purpose of informing investors or potential investors and their advisors.** They include, but are not limited to, annual and quarterly company reports, press releases, information memoranda, technical papers, website postings and public presentations of Exploration Results, Mineral Resources and Ore Reserves estimates.

Table 5
Contained metal tonnages (× 10[6] tonnes).[a]

	Clarion-Clipperton Zone Nodules[b]	Global Terrestrial Reserve Base[c]	Global Terrestrial Reserves[c]	Prime Crust Zone[b]
Manganese	5,992	5,200	630	1714
Copper	226	1,000+	690	7.4
Titanium	67	899	414	88
TREO[d]	15	150	110	16
Nickel	274	150	80	32
Vanadium	9.4	38	14	4.8
Molybdenum	12	19	10	3.5
Lithium	2.8	14	13	0.02
Cobalt	44	13	7.5	50
Tungsten	1.3	6.3	3.1	0.67
Niobium	0.46	3.0	3.0	0.40
Arsenic	1.4	1.6	1.0	2.9
Thorium	0.32	1.2	1.2	0.09
Bismuth	0.18	0.7	0.3	0.32
Yttrium	2.0	0.5	0.5	1.7
PGM[e]	0.003	0.08	0.07	0.004
Tellurium	0.08	0.05	0.02	0.45
Thallium	4.2	0.0007	0.0004	1.2

[a] Metals highlighted in red are those with greater tonnages than terrestrial reserves or terrestrial reserve bases.
[b] Nodule tonnage used is 21,100 million dry tonnes and crust tonnage used is 7533 million dry tonnes (from Hein and Koschinsky, 2013).
[c] USGS 2009 reserve base & 2012 reserves (reserve base includes those resources that are currently economic (reserves), marginally economic, and subeconomic).
[d] Total Rare Earth Elements as Oxides.
[e] Total Platinum Group Metals.

Hein et al 2013 Deep-ocean mineral deposits as a source of critical metals for high- and green-technology applications: Comparison with land-based resources Ore Geology Reviews 51 (2013) 1–14

This report indicates that the production of **a single tonne of refined REE oxide from Bayan Obo**, the world's most important REE deposit, also produced **63 000 m3 of harmful S- and F-bearing gases**, 200 m3 of acidic water, and 1.4 t of radioactive waste (especially Th-related wastes). **The safe disposal of these wastes**, especially the radioactive wastes that are often produced during REE production, **is a significant problem that needs to be overcome during REE mine planning and remediation**. Rare earth element mining and processing also involves a wide range of **occupational hazards** such as pneumo-coniosis as well as potential occupational poisoning from Pb, Hg, benzene, and phosphorous.

Weng et al. 2013 *Assessing rare earth element mineral deposit types and links to environmental impacts*. Applied Earth Science (Trans. Inst. Min. Metall. B)

ISA/SOPAC DSM EIA November 2011, Fiji -Working Group 3.

- inadequate capacity
- inadequate funding models
- knowledge management
- regional co-operation

SOPAC DSM Workshop June 2011
Governance, EITI++

Understanding Environment Impacts of DSM

- demonstrated concerns/problems at a national level/ pacfific region
- overcoming (previously) identified gaps - capacity, governance
- overcoming the knowledge vacuum
- SEA, Community Advisory Councils
- l

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